1ST AND 2ND ORDERS PROCESSES AND PROPERTIES INDEX 3RD AND 4TH ORDERS

B

13

Long-Time Hardness Tests. (In Russian.) A. P. Gulyaev and E. P. Trusova. *Zavodskaya Laboratoriya* (Factory Laboratory), v. 15, July 1949, p. 842-844.

Describes method for the above, using a Brinell tester, in which the ball is pressed into the specimen at high temperatures for an extended period of time (30 sec., 10 min., 30 min., etc.). Method was applied to study of the influence of alloying elements (0.5, 1.0, 2.0, 3.0 and 5% Zn or Mg) on the properties of solid solutions of Al-Zn or Al-Mg. Obtained data, tabulated, and charted, indicate inapplicability of the method to determination of heat resistance.

COMMON ELEMENTS OPEN MATERIALS INDEX COMMON VARIABLES INDEX

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

PROCESSES AND PROPERTIES INDEX

A

J

18B-394. **Low-Temperature Treatment of High Speed Tools.** (In Russian.) A. P. Gulyaev, P. P. Orudov, and A. A. Badaeva. *Stanki i Instrument* (Machine Tools and Instruments), v. 20, Mar. 1949, p. 3-6; Apr. 1949, p. 16-18.

The influence of low-temperature treatment on the cutting properties of tools. Application of very low temperatures, down to −100° C., immediately after heat treatment. Comparative data for different toolsteels.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

A

Q

9-274. METAL HARDNESS TESTS. [A. P. Gulyaev and R. I. Mitel'berg.] Chemical Age, v. 61, Sept. 3, 1949, p. 323-324.
Previously abstracted from Zavodskaya Laboratoriya (Factory Laboratory). See item 9-194, 1949.

ASM-SLA METALLURGICAL LITERATURE CLASSIFICATION

GULYAYEV, A.P.

PHASE I TREASURE ISLAND BIBLIOGRAPHICAL REPORT AID 329 - I

BOOK Call No.

Author: GULYAYEV, A. P.
Full Title: TRANSFORMATION OF AUSTENITE TO MARTENSITE
Transliterated Title: Prevrashcheniye austenita v martensit
Publishing Data
Originating Agency: All-Union Scientific Engineering and Technical Society of Machine Builders. Urals Branch
Publishing House: State Scientific and Technical Publishing House of Machine Building Literature ("Mashgiz")
Date: 1950 No. pp.: 25 No. of copies: 3,000
Text Data
This is an article from the book: VSESOYUZNOYE NAUCHNOYE INZHENERNO-TEKHNICHESKOYE OBSHCHESTVO MASHINOSTROITELEY, URAL'SKOYE OTDELENIYE, THERMAL TREATMENT OF METALS - Symposium of Conference (Termicheskaya obrabotka metallov, materialy konferentsii), (p.48-72), see AID 223-II
Coverage: The author presents a general review grouped about five major characteristics of Russian investigations of the mechanism of the transformation of austenite to martensite.

The author's study of basic structural transformations follows the same idealized conception of the phenomenon as usually adopted in many branches of physical science. The

Prevrashcheniye austenita v martensit AID 499 - I

study of equilibrium system and equilibrium transformation is considered important in spite of its non-occurence in practice. The idealized mechanism of the martensite transformation also has important significance for correct representation of true phenomena. The equilibrium transformation, in the author's opinion, is usually distorted [illegible] of the secondary phenomena related to the formation [illegible], tension of relaxation, diffusional displacement, [illegible]

The scope of this review includes the following questions: Theory, temperature and structure of the martensite transformation, isothermic transformation of austenite to martensite, stability of austenite, effect of cooling velocity and finally some practical recommendations, among which is discussed the question of the temperature conditions at cold treatment, temporary conditions and the effect of cold treatment. 17 charts, 6 microphotographs, 2 tables.

Purpose: For scientific workers

Facilities: None

No. of Russian and Slavic References. [illegible]

Available: Library of Congress

7

C.A.

Soldering with hard solder in an electric furnace with a reducing atmosphere. A. P. Gulyaev and I. I. Kobin. *Avtomobil. i Traktor. Prom.* 1050, No. 8, 11-14.—The strength of bonds produced by this method exceeds the strength of pure Cu and may be taken as 15 kg./sq. mm. for calcns. The use of peat gas is recommended for creation of the reducing atm.

Marshall Sittig

USSR/Metals - Steel, Electron Microscopy **Nov 50**

"Application of High Magnifications for Studying the Structure of Steel," A. P. Gulyayev, A. G. Zavrazhin, I. A. Strel'nikov, All-Union Sci Res Toolmaking Inst

"Zavod Lab" No 11, pp 1335, 1336

Studied typical structures in steel, such as ferrite, perlite, troostite, and martensite, at high magnification of 70,000 X with aid of electron microscope. Discusses results of examn, illustrated with photomicrographs. Examd commercial iron, steel U10 and especially made steel U16 (1.54% C).

[redacted]

180T78

7

CA GULYAYEV, A.P.

Use of high magnifications for studying the structure of steel. A. P. Gulyaev, A. G. Zavrazhin, and I. A. Strel'nikov. *Zavodskaya Lab.* 16, 1335-6(1950).—Photomicrographs are presented showing structures of ferrite, troostite, and martensite at 1000× (optical microscope) and at 7000× (electron microscope). Low tensile strength of martensite is due to cracks visible at 7000×; these disappear on tempering. H. W. Rathmann

2

CA

Laws of variation of properties in solid solutions.
A. P. Gulyaev and E. F. Trusova. *Zhur. Tekh. Fiz.* **20,**
66-78(1950).—(1) Detns. of the Brinell hardness *H* and
of the lattice parameter were made for solid solns. in Al,
Fe, and Cu, with the following low contents of the ex-
traneous elements (in at. %): in Al, Zn (0.5-5), Ag
(0.5-5), Mg (0.5-5), Si (0.25-1.5), Cu (0.25-1.0);
in Fe, Si (1-5), Cr (1-5), Mn (1-5), Ni (1-5), Mo (1-4),
W (0.25-3); in Cu, Zn (0.5-5), Ni (0.5-5), Al (0.5-5),
Mg (0.5-5), Si (0.5-5), Mn (0.5-5), Sn (0.5-3). Alloys
of Fe and of Cu were investigated annealed; those of Al,
on account of the low soly. of the alloying elements at
equil. at room temp., were quenched to ensure nonequil.
homogeneity at room temp. In all cases, alloying was
found to increase *H* to various degrees, with the sole ex-
ception of Cr in Fe: up to 1 at. % Cr, alloying in this case
decreased *H*, with further increasing Cr content pro-
ducing a very slight increase. In solid soln. in Al, the
greatest hardening effect was produced by Cu, Mg, and
Ag, the latter at high contents. In solid soln. in Cu, the
effect of all alloying elements was very nearly the same,
a very marked increase of *H* produced by the 1st addns.,
followed by very much slower increase with further in-
creasing amt. of the alloying element. Sn, Mg, Si, and
Mn, are strong hardeners, whereas Ni, Zn, and Al, have a
much less pronounced hardening effect. In the Fe series,
the best hardeners are W, Mo, and Si, followed by Ni
and Mn, the latter up to 2 at. %; higher amts. of Mn
cause very considerable hardening, probably owing to
formation of a new structure (acicular ferrite) despite the
slow cooling. The lattice parameter *a* of the Al alloys
was found to be expanded by the addn. of Mg and Ag,
and contracted by Zn, Si, and Cu, in conformity with the
expectation that elements with an at. radius *r* greater
than that of Al should expand the lattice, those with *r*
smaller than Al, contract it; the extent of the expansion
or contraction increases with the difference of *r* of the
alloying element and of the host. By the same token,
in Cu alloys, only Ni (*r* smaller than Cu) was found to
contract the lattice, with all the other elements expanding
it, Sn and Mg most, Zn less. The effect of Si on *a* pre-
vents an anomaly; in the Al series, although it does have
a contracting effect, still that effect is much smaller than
could be predicted from the large difference between *r* of
Al and the very small Si. In the Cu series, Si has, sur-
prisingly, an expanding effect on *a*. This particularity is
evidently linked with the covalent nature of the bonding
of Si in the lattice. In the Fe series, Si contracts *a*, as it
should. Ni, expected to contract *a*, actually expands it
to the same degree as Mn and Cr; the greatest expanding
effect is produced by W and Mo, in conformity with the
considerable difference between their *r*s and the *r* of Fe.
Of the possible factors that can be presumed to be detg.
for the variation of *H* as a result of alloying with solid-
soln.-forming elements, the crystal-structure type of the
alloying element, as compared with that of the host,
cannot be one; among others, Mo and W, isomorphous
with α-Fe, have a most marked hardening effect, whereas
Mn and Ni, with a different type of lattice, have a much
less marked effect on *H*. Nor is there any clear paral-
lelism between hardening and the change of electron
concn. on alloying. In the Fe series, that concn. cannot
be detd. on account of the incomplete *d*-band; in the Al
series, there is an uncertainty about the degree of ionization
of Al in the lattice, and, even if Al is assumed to be present
as Al^{+++}, no correlation can be established between the
change of *H* and that of the electron concn. Such cor-
relation might, at most, be found in the Cu series, but only
there. The exptl. data permit only one generalization,
namely a correlation between the variation of *H* and

that of a. The greater the change of a, the more marked the hardening effect. Elements producing a contraction of a have a stronger hardening effect than elements causing an expansion of a. Instances of deviations from that general rule are Mg and Cu in the Al series, and Mn and Si in the Fe series; these pairs produce approx. equal changes of a, but very unequal changes of H. On the other hand, Zn and Ni in Cu produce about the same change of H, but have very different effects on a. The role of Cr in Fe is still unexplained. It is noteworthy that the hardening effect produced by an alloying element depends solely on the nature of that element, and is entirely independent of the nature of the host. (2) Elec. resistivity ρ was detd. for solid solns. in Al, with Zn (0.[illegible]-5.37), Ag (0.5-4.81), Si (0.183-0.74), Mg (0.57-4.[illegible]), Li (0.57-2.5), Cu (0.26-0.87); data for alloys of Cu and Fe were taken from Norbury (*C.A.* 19, 10[illegible]) and Linde (*C.A.* 27, 1306). From the point of view of their effect on ρ, alloying elements with complete electron shells, Zn, Mg, Al, Cu, Li, and Sn, produce an increase of ρ, the effect being the stronger, the greater the difference of the valencies of the alloying element and the host. This is particularly applicable to the Al series, if the host is considered as having the valency 3. Similarly, in the Cu series, Sn has the strongest ρ-increasing effect, followed, in that order, by Al and by Zn and Mg. [illegible] with incomplete inner shells, Mn, Ni, Cr, Co, [illegible], give rise to more complex effects. In the Cu series, [illegible] increases ρ to a greater extent than Ni, and in the Fe series, Ni has the least effect on ρ; no clear correlation between the electronic structure and the change of ρ can be established for the other transition elements. Si has a particularly strong ρ-increasing effect owing to its tendency to covalent bonding. Norbury's rule of the dependence of the change of ρ on the (horizontal) distance in the periodic system between the alloying and the host element is verified only for elements with complete shells, not for transition elements.

N. Thon

GULYAEV, A. P.

Metallovedenie. 2., perer. izd. Dop. v kachestve uchebnika dlia mashinostroitel'nykh vuzov. Moskva, Oborongiz, 1951. 484 p. illus., ports.

Includes bibliographies.

(Metallography. 2nd ed.)

DLC: TN690.G10 1951

SO: Manufacturing and Mechanical Engineering in the Soviet Union, Library of Congress, 1953.

APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R000617320008-4"

GULYAYEV, A. P.

"Heat Treatment of Instrument Steels," Moskva, Mashgiz, 1951

PA 193T82

GULYAYEV, A. P.

USSR/Metals - Martensite Oct 51

"Effect of Alloyed Elements on Temperatures of Martensite Transformations," V. G. Vorob'yev, A. P. Gulyayev

"Zhur Tekh Fiz" Vol XXI, No 10, pp 1159-1163

Authors show experimentally that alloying elements (Mn, Cr, Ni, Mo) lower temps at which martensite transformation starts. Linear relation of such transformation temp to concn of alloys appears in all cases. Alloyed elements lower temps at which transformation ends. Editorial note criticizes these results adversely. Submitted 10 Apr 50.

193T82

PA 193T83

GULYAYEV, A. P.

USSR/Metals - Martensite

Oct 51

"Transformation of Austenite to Martensite at Temperatures Below Zero. II," V. G. Vorob'yev, A. P. Gulyayev

"Zhur Tekh Fiz" Vol XXI, No 10, pp 1164-1169

Previous work by authors (ibid. pp 1159-1163) paved way for practical recommendations for heat treatment of steel at temps below freezing. The location of point M (start of martensite formation) determines efficiency of cold treatment and amount of austenite formed and its hardness. Submitted 10 Apr 50.

193T83

[illegible]. A

J. Heat

117-J. The Formation of Cracks During Heat Treatment of Tools. (In Russian.) A. P. Guliaev and S. P. Yakushev. *Stanki i Instrument*, v. 22, Aug. 1951, p. 26-27.

Data are charted and discussed. (J general, TS)

GULYAYEV, A.P.; KUZNETSOV, I.V.; TIKHONRAVOVA, T.L.; MATVEYEVA, Ye.N., tekhnicheskiy redaktor

[Stabilization of the dimensions of ball-bearing races by means of cold treatment in tempering] Stabilizatsiia razmerov kolets podshipnikov putem obrabotki kholodom pri zakalke. Moskva, Gos. nauchno-tekhn.izd-vo mashinostroitel'noi lit-ry, 1952. 25 p. [Microfilm] (MLRA 9:3)

(Ball-bearings) (Steel--Metallurgy)

18(7) PHASE I BOOK EXPLOITATION SOV/1843

Gulyayev, A. P. and Ye. V. Petunina

Metallograficheskoye issledovaniye prevrashcheniya austenita v martensit (Metallographic Investigation of the Austenite-Martensite Transformation) Moscow, Mashgiz, 1952. 90 p. (Series: Tsentral'nyy nauchno-issledovatel'skiy institut tekhnologii i mashinostroyeniya. [Trudy] kn. 47) 3,000 copies printed.

Reviewer: N. A. Pasternak, Engineer; Tech. Ed.: Ye. N. Matveyeva; Managing Ed. for Literature on Heavy Machine Building (Mashgiz): S. Ya. Golovin, Engineer.

PURPOSE: This book is intended for scientific personnel at research institutes and industrial laboratories.

COVERAGE: Methods of investigating the austenite-martensite trans-

Card 1/6

formation are described. In particular, metallographic methods of study are discussed, and the design of an instrument in current use is described. The theory of the martensite transformation is set forth, particular emphasis being laid on the ideas that nuclei of martensite crystals appear as a result of plastic deformation of austenite grains and that shear planes serve as centers of crystallization. Personalities mentioned as having made contributions in this field include G. V. Kurdyumov, N. T. Gudtsov, and N. Ya. Selyakov. There are 25 references, of which 23 are Soviet, 2 German, and 1 English.

TABLE OF CONTENTS:

Metallographic Investigation (Cont.) SOV/1843

AVAILABLE: Library of Congress

GO/bg
7/16/59

Card 6/6

GULYAYEV, A.P.

USSR

Röntgenographic investigation of high-chromium steel. A. P. Gulyaev and Ya. R. Sanchuk. *Zhur. Tekh. Fiz.* 22, 1718-27(1952).—It has been shown that variation in C content in solid soln. in chrome steel X12Ф1 (C 1.5, Cr 11.3, V 0.77%) as a result of change of quenching temp. obeys the rules of Kurdyumov and others for C steels. Correction for the presence of Cr in detn. of martensite lattice spacing is not large, $a = 2.861 + 0.0006r - 0.015p$, $c = 2.861 + 0.0005 - 0.118p$, $c/a = 1 + 0.0467p$ (2.861 is lattice spacing of α-Fe, p = wt. % C, r = wt. % Cr in soln.), and C steel consts. can be used for analysis of martensite in alloy steels. Effect of Cr on austenite lattice is apparently more intense and C steel consts. cannot be used. Phase compn. of X12Ф1 steel in annealed and a range of quenching temps. is shown. V. N. Bednarski

GULYAYEV, A.P.

Problems of metallography and thermal treatment applicable to surface hardening with high-frequency currents. [Izdaniia] LONITOMASH no.30: 230-240 '52. (MLRA 8:1)
(Metals--Hardening)

GULYAYEV, A. P.

Termicheskaya obrabotka stali. Heat treatment of steel. Moskva, Mashgiz, 1953.
383 P. illus., diagrs., tables.
"Literatura": P. 369-381

USSR/Metallurgy - Refrigeration of Steel, Retained Austenite — Feb 53

"Stabilization of Retained Austenite," A. P. Gulyayev, M. S. Chaadayeva

Zhur Tekh Fiz, Vol 23, No 2, pp 252-264

Defines stabilization of retained austenite as reduction in austenite capability of transformation to martensite in case of interruption in cooling. Considering this phenomenon unfavorable to sub-zero treatment of steel, investigates three factors which

270T94

affect stabilization of austenite, namely: effect of duration of holding period at given temp (-20 and $-50^{\circ}C$); effect of temp of isothermal holding; effect of chem compn (C content) of austenite. Discussing theoretical substantiation of stabilization phenomenon, authors suggest only possible (in their opinion) assumption that stabilization of retained austenite is caused by stress relief during isothermal holding.

270T94

Metallographic investigation of the transformation of austenite into martensite. A. P. Gulyaev and [illegible] *Zhur. Tekh. Fiz.* 21, 602-12 (1951).—Detailed discussion of many photomicrographs.

F. R. Darash

2

GULYAEV, A.P.

USSR.

Interlamellar distances in products of isothermal transformation of austenite in carbon steel. A. I. Gardin and A. P. Gulyaev. *Zhur. Tekh. Fiz.* 23, 2001-12(1953).—The interlamellar distances of product of isometric disintegration of austenite were measured over a wide range of temp. (260-700°). Products of A_r'' transformation differ from products of A_r' transformation by large interlamellar distances (at same temp. of disintegration) and smaller length of lamella. The change of mechanism of transformation of austenite in carbon steel is observed in the interval 450-550°. The influence of interlamellar distance on hardness is elucidated. V. N. Bednarski

[illegible], A. F.; CHAADAEVA, M. S.

"Stabilization of Retained Austenite During Cold Treatment of Steel," Vestnik Mashinostroyeniya 33 (1953) pp 37/42.

B-84590, 26 Apr 55

Chemical Abst.
Vol. 48 No. 4
Feb. 25, 1954
Metallurgy and Metallography

chem (2)

Gradual hardening in fused alkali hydroxides. A. P. Gulyaev, E. A. Lebedeva, and V. V. Sokolovskaya. *Vestnik Mashinostroeniya* 33, No. 8, 79-81(1953).—The properties and use of fused KOH + NaOH baths for stepwise hardening is outlined.
M. Hosch

MF
7-19-54

GULYAYEV, A.P., doktor tekhnicheskikh nauk, professor. MATVEYEV, Ye.N., tekhnicheskiy redaktor; SOKOLOV, T.F., tekhnicheskiy redaktor

[Properties and heat treatment of tool steels] Svoistva i termicheskaia obrabotka instrumental'nykh stalei. Pod red. A.P.Guliaeva. Moskva, Gos. nauchno-tekhn. izd-vo mashinostroit. i sudostroit. lit-ry, 1954. 77 p. (MLRA 7:8)
(Tool steel)

GULYAYEV, A.P., doktor tekhnicheskikh nauk, professor, redaktor; MO-DEL', B.O., tekhnicheskiy redaktor; MATVEYEV, Ye.N., tekhnicheskiy redaktor.

[Investigation of the structure of tool steels; collection of articles] Issledovanie struktury instrumental'nykh stalei; sbornik statei. Pod red. A.P.Guliaeva. Moskva, Gos.nauchno-tekhn. izd-vo mashinostroit. i sudostroit. lit-ry, 1954. 136 p. (MLRA 7:11)

1. Moscow. Vsesoyuznyy nauchno-issledovatel'skiy instrumental'nyy institut.
(Tool steel--Metallography)

ZAKHAROV, V.P.; GULYAYEV, A.P., professor, doktor tekhnicheskikh nauk, retsenzent; PLOKHOV, B.G., inzhener, retsenzent; DUGINA, N.A., tekhnicheskikh redaktor

[The universal heat-treatment furnace operator] Termist-universal. Izd. 3-e. Moskva, Gos. nauchno-tekhn. izd-vo mashinostroitel'noi lit-ry, 1954. 240 p. (MLRA 8:4)
(Steel--Heat treatment)

GULYAEV, A. P.

"Transformation Processes in Steel During Hardening," from Modern Methods of Heat Treating Steel by Dom Inzhenera i Tekhnika imeni F E Dzerzhinskovo. Gosudarstvennoye Nauchno-Tekhnicheskoye Izdatel'stvo Mashinostroitel'noy Literatury, Moscow (1954) 404 pp. pp 5/23.

Evaluation B-86350, 30 Jun 55

USSR/Engineering-Metallurgy FD-1380

Card 1/1 : Pub. 41-7/18

Author : Gulyayev, A. P. and Zel'bet, M. P.

Title : Metallographic study of the tempering process in hardened high-carbon steel

Periodical : Izv. AN SSSR. Otd. tekh. nauk 3, 83-87, March 1954

Aubstract : Studies austenite-matensite transformation by metallographic method using steel specimens with coarse grains of austenite. Diagrams, micrographs, three references.

Institution :

Submitted : February 10, 1954

USSR/Engineering-Metallurgy FD-1381

Card 1/1 : Pub. 41-8/18

Author : Alfimov, A. N. and Gulyayev, A. P.

Title : On the rate of growth of martensite crystals

Periodical : Izv. AN SSSR. Otd. tekh. nauk 3, 88-90, March 1954

Abstract : Describes experiments conducted in ultrasonic laboratory of TsNIITMASh (Central Scientific Research Institute of Technology and Machine Building) for measuring formation time of martensite crystal, using cathode-ray oscilloscope. Illustration of experimental device is given. Four references; 1 USSR.

Institution :

Submitted : February 10, 1954

GULYAYEV, A. P.

3/

Some Special Features of Martensite [illegible] as Shown by Metallographic Analysis. A. N. [illegible] and A. P. Gulyaev. (*Izvest. Akad. Nauk SSSR, Otdelenie Tekn. Nauk*, 1954, (4), 93–99). [In Russian]. Metallographic investigation of martensite transformation in steel specimens (1·0–1·6% C; 2·6–3·0% Mn) with a coarse grain austenite structure during cooling in liquid nitrogen is described. In the course of the transformation deformation and division of initially formed martensite crystals and their displacement from the initial positions was observed. During this process spaces between martensite fragments are filled with austenite. Thus as a result of martensite transformation, austenite is strongly deformed which may explain the auto-inhibition of the martensite reaction.—V. G.

Df

GULAYEV, A. P.

FD-594

USSR/Metals - Austenite conversion

Card 1/1 : Pub 153-6/22

Author : Gulayev, A. P., and Zalkin, V. M.

Title : Effect of heating speed on the position of the temperature interval of conversion of pearlite into austenite

Periodical : Zhur. tekh. fiz. 24, 216-221, Feb 1954

Abstract : Analyze the effect of heating speed on the position of the "critical point" i.e. the point of quickest conversion of pearlite into austenite. Assume that the accuracy of the experimental determination of temperature interval depends on the inertia of the recording equipment and on the temperature scale and sensitivity of the oscillograph. Results are plotted in graphs. 9 references.

Institution :

Submitted : June 28, 1953

FD-535

GULAYEV, A. P.

USSR/Metals - Steel heating

Card 1/1 : Pub 153-7/22

Author : Gulayev, A. P. and Zalkin, V. M.

Title : Problem of analyzing the thermal curves of velocity heating of steel

Periodical : Zhur. tekh. fiz., 24, 222-226, Feb 1954

Abstract : Because the heating speed varies at conversion points (see previous abstr.) due to emission or absorption of latent heat, these points are easily found on thermal curves. But with increasing conversion speed the heat balance varies and decalescence occurs, i.e. the temperature drop as a result of conversion. These assumptions are experimentally confirmed and plotted in graphs. No references.

Institution :

Submitted : June 18, 1953

GULYAYEV, A.P.

Gulyaev, A.P. + Aksheu'tseva, A.P.

slower cooling in this range facilitates the transformation of austenite to martensite, since, with time, elastic deformation can pass into plastic leading to martensitic crystal formation. Austenite transforms into martensite on heating from [illegible] only when its cooling in the range below [illegible] was sufficiently fast to prevent martensite formation. With the martensite range in the neg. temps. the intensity of its formation depends on the temp. of the isothermal hold and on the speed of cooling to the isothermal temp. For each quenching temp. there is an optimum [illegible] leading to a max. transformation. There is [illegible]

RG MT

GULYAYEV, A. P.

Gulyaev, A. P.: Metallovedenie (Metallography). 3rd ed. Moscow: Gosudarst. Izdatel. Obor. Prom. 1956. 344 pp.

GULYAYEV, A. P.

Study of third [stage] transformation during tempering of steel. A. P. Gulyaev and N. T. Barona. *Metalloved. i Obrabotka Metal.* 1955, No. 1, 40-41.—Third-stage transformation occurs during tempering in the range 300 to 400°. The present work intended to show that the principal process in this tempering is recrystn. rather than the transformation of Fe_2C into Fe_3C. C steels contg. 0.04 to 1.25% C were quenched in a 10% NaOH soln. from a temp. 30 to 50° above A_3. [illegible] dilatometric studies up to 600° [illegible] standard were made on the [illegible] steels: (a) as quenched, (b) after tempering at 280°, [illegible] after being cooled to the temp. of liquid N_2 and then tempered at 280°. The 0.04 C steel showed 3rd stage transformation (3rd s.t.) only in state (c). The remaining steels showed 3rd s.t. in all 3 states. The most intense transformation occurred in the range 280 to 450°. The amt. of C did not det. the temp. of 3rd s.t., but a preliminary tempering below the temp. of 3rd s.t. raised the transformation temp. while a treatment in liquid N_2 lowered it. The amt. of 3rd s.t. increased to a max. with increase in C up to 0.6% and then remained about const. Increasing the rate of cooling in the martensite interval or cooling to the temp. of liquid N_2 increased the vol. effect during 3rd s.t. This result was explained as an increase in stresses of the second kind. Stresses of the first kind did not affect 3rd s.t. since quenched specimens of various dimns. showed the same dilatometric effects. The mechanism of decrease in stresses of the second kind was the breaking of coherency between the carbide phase and the matrix and the process of recovery. A dilatometric effect in the range of temp. 400 to 600° was attributed to further relief of stresses accompanying coagulation of carbides, since it did not occur in C-free alloys or in plastically deformed specimens. Change in sp. vol. was detd. [illegible] weighing on steels [illegible] C] after quenching and [illegible] in the range 170 to 600°. The results were similar to those obtained dilatometrically. Pure Fe and 2 steels were cold-worked 10 to 75% by wire drawing and the change in sp. vol. accompanying annealing at temps. from 100 to 600° was detd. The temp. of the transformation and the extent of vol. change, about 0.0005 cc. per g., were similar to those found in 3rd s.t. Stresses of the second kind were detd. from measurements of line widths on x-ray patterns obtained from steels contg. 0.30, 0.60, and 1.07% C that had been quenched and then tempered in the range 300° to 650°. The stresses fell continuously, but they fell most rapidly in the range 350 to 450°. A. G. Guy

GULYAYEV, A.P.

1613* Phase Transformations in Steel With Rapid Electrical Heating. Fazovye prevrashcheniia v stali pri skorostnom elektronagreve. (Russian.) A. P. Guliaev and V. M. Zalkin. *Metallovedenie i obrabotka metallov*, 1955, no. 2, Aug., p. 15-20.

Transformation kinetic curves of perlite to austenite during continuous heating; effect of heating rate on transformation; kinetics of isothermal transformation. Graphs. 8 ref.

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GULYAYEV, A. P.

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18 4E2c

The phenomenon of recovery in the process of tempering of high-carbon steels. A. P. Gulyaev. *Trudy Vsesoyuz. Zaochn. Mashinostroitel. Inst.* 1955, No. 2, 120-6; *Referat. Zhur., Met.* 1956, No. 3539.—Steel contg. C 1.38, Mn 0.15, and Si 0.17%, and Cr and Ni traces was rapidly heated to 1200-1300°, and held there for 4 sec. to insure complete soln. of carbide in austenite. On tempering at 100° for 1 hr., partial sepn. of C from the soln. occurred. Further tempering of the same sample at 300° for 2 sec., redissolved the C. Tempering for 1 hr. at 200° caused almost complete pptn. of C. The secondary appearance of supersatd. solid soln., after the brief tempering (200° and 2 sec.), of the previously low-tempered martensite (100° and 1 hr.) is attributed to the instability at higher temp. of the carbides pptd. at low temp.; thus they dissolved but could not sep. completely at the higher temp. because of the shortness of time of tempering. In this manner the phenomenon of recovery occurs.

Alexis N. Pestoff

GULYAYEV, D. P

The transformation of [illegible] into [illegible] at [illegible]

[illegible]

Gulyaev, A.P.

4E2C

Martensite transformation. A. P. Gulyaev. Trudy Nauch.-Tekh. Obshchestva Chern. Met. 3, 51-72(1955); Referat. Zhur., Met. 1956, No. 699.—The supposition of decreasing velocity of crystal growth of martensite with the decrease in temp. is rejected. It was shown by high-speed cinematography at −180-5°, that the needles of martensite appear in less than $^1/_{500}$-$^1/_{00}$ sec., and by means of a cathode oscillograph that the time of formation of martensite plates is $<10^{-6}$ sec. Martensite graphs were obtained during uninterrupted cooling to −253°. Metallographic analysis indicates that the martensite transformation is an orderly rearrangement of atoms without interchange of places. At the same time the movement of atoms is far greater than interatomic distances. The energy for the transformation is created by a plastic deformation, produced by the stresses that result from temp. changes. The seat of the transformation is the gliding plane of the austenite. On one hand, the increase in the rate of cooling results in the increase of stresses, and thus promotes martensite transformation. On the other hand, it is equivalent to an increase in the velocity of loading, and thus decreases the metal capacity for plastic deformation; this, in turn, must result in a decrease in a degree of transformation, especially at lower temp. Stabilization during martensite transformation and different effects of rate of cooling are explained from the point of view of stresses. A. N. P.

GULYAYEV, A.P.

62

The kinetics of isothermal austenite formation. A. P. Gulyaev and V. M. Zulkin. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk.* 1955, No. 6 114-18.—The steel samples were heated at the rate of 60°/sec. to 745, 755, and 770° by passing a.c. through the sample, and then keeping it isothermally at the required temps. (within ±3-5°), by periodically turning the current on and off. Temp. changes were recorded oscillographically. The kinetic curves constructed indicated some pearlite-austenite transformation before the temp. reached the required level. With the heating rate used, nearly 10% austenite would form by the time 760° temp. is reached, 50% with the 790°, and by the time 820° is reached 100% pearlite has been transformed.

W. M. Sternberg

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GULYAYEV, A.P.

62 Theory of phase transformation in steel during heating. A. P. Gulyaev and V. M. Zalkin. *Izvest. Akad. Nauk S.S.S.R., Otdel. Tekh. Nauk* 1955, No. 7, 93-5.—The continuous transformation process of pearlite into austenite was investigated with a continuous heating with a.-c. to steadily rising temps. of 650-900°, and quenching. The amount of austenite formed was detected metallographically on the quenched samples, and expressed in a curve. Several conclusions were reached from the kinetic and thermal transformation curves. All the kinetic curves are extrapolated to the same initial temp. The transformation range is the wider the greater the heating rate. At sufficiently slow heating rate, at conditions approaching equil., all the heat supplied from the outside from the beginning of transformation is consumed in the endothermic process. At higher heating rates, the initial and final transformation stages account for increasingly larger proportion of transformation, reducing the intermediate isothermic stage, which is displaced towards higher temps. W. M. Sternberg

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FD-3046

USSR/Metals - Austenite transformation

Card 1/2 Pub. 153 - 15/23

Author : Gulyayev, A. P.; Akshentseva, A. P.

Title : Influence of speed of cooling on kinetics of transformation of austenite to martensite

Periodical : Zhur. tekh. fiz., 25, February 1955, 299-312

Abstract : The authors state that study of the influence of cooling rate on transformation of austenite to martensite is important for the technology of steel tempering (knowing this influence one can direct and change the course of the martensite reaction during tempering) and also for the acquisition of new data on the nature of this important phase transformation. They describe experiments conducted mainly on steels of the type Kh12F1 (1.4%C, 11.1%Cr, 0.7%V), this type being chosen because one can obtain in it by chance alone in the tempering temperature austenite of various compositions which has various temperatures of the martensite interval. They conclude that increase in the cooling rate at all temperatures increases the total effect of transformation and in

Card 2/2 FD-3046

Abstract : the end increases the quantity of martensite and that the new facts obtained clarify the leading role of stress in the formation of nuclei of the martensite phase (ibid., 23, 4, 1953). Further, at high temperatures increase of the cooling rate and increase of stresses cause increase in the martensite phase, etc. Seven references.

Institution : -

Submitted : November 1, 1954

GULYAYEV, A.P.

USSR/Solid State Physics - Phast Transformations in Solids, E-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34682

Author: Alfimov, A. N., Gulyayev, A. P.

Institution: None

Title: Investigation of Martensitic Transformation in Steel

Original Periodical: Zh. Tekhn. Fiziki, 1955, 25, No 4, 680-686

Abstract: An investigation was made of the effect of the dimensions of the grain and of the dimensions of the specimens of the kinetics of the martensitic transformation in steel, and also the position of the temperature of the start of the martensitic transformation as a function of the sensitivity of the investigation methods. The investigation was carried out in a high-sensitivity thermomagnetic installation (Referat Zhur - Fizika, 1956, 22693). The specimens were made of steel containing (in percent) 1.5 C; 0.76 Si; 3.4 Mn. It is shown that when the sensitivity of the installation is reduced from 1 x 10^{-5} to 5 x 10^{-1}%, the temperature at which the first noticeable amounts of martensite were established dropped from -50 to -82°. The martensitic transformation takes place in jumps; the kinetic curves of the transformation, corresponding to the high sensitivity, are in the form

USSR/Solid State Physics - Phase Transformations in Solids, E-5

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34682

Author: Alfimov, A. N., Gulyayev, A. P.

Institution: None

Title: Investigation of Martensitic Transformation in Steel

Original Periodical: Zh. Tekhn. Fiziki, 1955, 25, No 4, 680-686

Abstract: of a staircase. The experimentally-determined temperatures of the start of the martensitic transformation have a large dispersion, which increases with increasing sensitivity of measurement. As the specimen diameter is decreased, other conditions being equal, the martensitic point of the steel becomes lower. The same results are obtained by increasing the grain size. Consequently, the more grains there are in a cross section of the specimen, the higher the martensitic point. In monocrystals, the martensitic conversion does not occur even when the specimen is cooled to the temperature of liquid air. The influence of the size of the grain and of the dimensions of the specimen on the martensitic transformation is explained by the authors from the point of view of the decisive role of the second-kind stresses during the process of transformation of austenite into martensite.

GULYAYEV, Aleksandr Pavlevich; BOGACHEV, I.N., doktor tekhnicheskikh nauk, professer, retsenzent; KUNYAVSKIY, kanditat tekhnicheskikh nauk, detsent, redaktor; PETROV, I.A., redakter; ZUDAKIN, I.M., tekhnicheskiy redaktor.

[Physical metallurgy] Metallevedenie. Izd. 3-e, perer. Moskva. Gos. izd-vo ebor.premyshl., 1956. 343 p. (MIRA 9:6)
(Physical metallurgy)

GULYAYEV, A. P.

Influence of residual austenite, obtained during quench-ing, on the impact strength and fracture appearance in a well-tempered chromium-nickel-molybdenum steel. A. P. Gulyaev and I. I. Slavina (Moscow Machine Construction Institut Inst.). *Metalloved. i Obrabotka Metallov* 1956, No. 3, 15-17.—Specimens 11 × 11 × 55 mm. of steel 25KhNMA (0.26% C, 1.3 Cr, 3.0 Ni, 0.30 Mo) were aus-tenitized at various temps., 800–1000°, and then quenched at various rates. The amts. of retained austenite after quenching in water, oil, and air were 0, 2, and 4%, resp., and were almost independent of the austenitizing temp. Specimens cooled in the furnace at 1.5-2° per min. had a min. of retained austenite, 0%, when austenitized at 950°. The amt. at 800° was 14%, and at 1000°, 8%. The Rock-well hardness decreased from 50 for 0% retained austenite to 30.5 for 10%. All of the specimens were tempered 1 hr. at 630° and then oil-quenched. No austenite remained, all of the specimens had the same hardness, the impact strength at room temp. were the same 10-11 kg.-m./sq. cm., and all the fractures were fibrous. Impact tests were made at temps. down to −200°. The specimens quenched in water, oil, and air behaved similarly and had a transition temp. of about −120°. The furnace-cooled specimens had a transi-tion temp. of −40°. Also, the fracture at −196° was completely cryst. for the furnace cooled specimens but was 30% fibrous for the quenched specimens. A. G. Guy

Category : RUMANIA/Solid State Physics - Phase transformation of solid bodies E 5

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1176

Author : Guliaev, A.P., Zulkin, V.M.
Title : On the Kinetics of the Isothermal Formation of Austenite.

Orig Pub : An. Rom.-Sov. Metalurgie si constr. masini, 1956, 10-No 1, 14-18

Abstract : See Ref. Zhur. Fiz., 1956, 28649

Card : 1/1

GULYAYEV, A-P

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GULYAEV, A.P.; MALININA, K.A.

Isothermal transformation of austenite in high-speed steel. A. P. Gulyaev and K. A. Malinina. *Metalloved. i Obrabotka Metal.* 1956, No. 12, 2-8.—An exptl. study was made of steel R9 (C 0.9, Cr 4.3, W 9, V 2.3%). The types of heat-treatment used were: (a) austenitizing at 900° followed by isothermal transformation for 5 hrs. at 750 to 100°; (b) the same except 1220° austenitizing; (c) 1220° austenitizing, cooled to 20° and isothermally transformed at 700 to 100°; (d) the same as c except cooled to −78°; (e) the same as c except held 30 min. at 560° before isothermal transformation at 500 to 100°; (f) the same as e except the time was 1 hr.; (g) the same as e except the time was 5 hrs. The amt. of austenite and its compn. after austenitizing at 900° and at 1220° was: 900°, 87%, W 2.0, Cr 2.0, V 0.3%; 1220°, 96%, W 7.4, Cr 4.2, V 1.4%. The amt. of martensite after austenitizing at 1220° and cooling to 20° and to −78° was: 20°, 60%; −78°, 76%. The amt. carbide phases at the beginning of isothermal transformation for various treatments were: c 4.0; e 4.4; f 6.8; g 6.8%. The amt. of isothermal transformation was detd. by magnetic measurements. Temp.-time-transformation (TTT) diagrams were constructed for primary austenite produced at 900°, primary austenite produced at 1220°, retained austenite, and tempered retained austenite. Diagrams were also given showing the phase compn. and the hardness after 5-hr. transformation. The TTT diagrams for primary austenite showed zones corresponding to pearlite, bainite, and martensite. The diagrams for retained austenite lacked the bainitic and martensitic zones and showed a faster pearlite reaction the larger the amt. of martensite. The diagrams for tempered

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GULYAEV, A.P.; MALININA, K.A.

retained austenite showed bainitic and martensitic zones. On the basis of the exptl. results recommendations were made for improving various heat-treatments of this steel. For annealing after hot-working: 1 hr. at 750°, air cool. For annealing after welding: hot welded parts held at 750° for 6 hrs., cooled to 500°, and then air cooled. For step quenching: 5- to 10-min. treatment in a bath at 250 to 600°. For bainitic treatment: quench to 500° and hold for 3 hrs., temper at 500° for 1 hr., cool to 250° and hold for 5 hrs., cool to room temp., and then repeatedly temper for 1 hr. at 500°.

A. G. Guy

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GULYAYEV, A.P.

A Scale of Martensite Microstructures. A. P. Gulyaev, A. A. Kolesnova, and E. I. Baunkina. (*Zavodskaya Laboratoriya*, 1956, 22, (3), 314-315). [In Russian]. A series of martensite microstructures at magnifications of 600 are presented facilitating decisions on whether or not steel has been overheated during hardening. The appropriate structures for various steels are indicated.—a. x.

MT

137-58-6-13237

Translation from: Referativnyy zhurnal, Metallurgiya, 1958, Nr 6, p 295 (USSR)

AUTHOR: Gulyayev, A.P.

TITLE: Problems of Modern Metallography (Problemy sovremennogo metallovedeniya)

PERIODICAL: V sb.: Sovrem. napravleniya v obl. tekhnol. mashinostr. Moscow, Mashgiz, 1957, pp 281-289

ABSTRACT: Bibliographic entry

1. Metallurgy--USSR

Card 1/1

AUTHOR: Gulyaev A.P., Doctor of Technical Sciences, Professor, and Neverova-Skobeleva, N.P., Engineer. 129-4-4/17

TITLE: Influence of carbon on the position of the critical range of cold brittleness. (Vliyanie ugleroda na polozhenie kriticheskogo intervala khladnolomkosti.)

PERIODICAL: "Metallovedenie i Obrabotka Metallov" (Metallurgy and Metal Treatment) 1957, No. 4, pp. 17 - 21 (U.S.S.R.)

ABSTRACT: The authors considered it advisable to investigate experimentally the influence of the carbon content on the location of the critical temperature range of cold brittleness of heat-treated steel of a given grade with differing carbon contents and also the influence of the carbon content on the location of the critical temperature range of cold brittleness of brittle and of non-brittle steels. Cr-Ni-Mn-V steel of four different compositions, as specified in Table 1, p. 17, were investigated. The steel was produced in a laboratory 150 kg induction furnace with basic lining of the crucible. From the ingots sheets of 30 x 220 mm were rolled and from these notch impact specimens of 11 x 11 x 55 mm were cut in the longitudinal direction. After normalisation the specimens were hardened and tempered at a high temperature under regimes specified

in Table 2. To obtain equal hardness the duration of the tempering was varied in accordance with the carbon content. For steels in the tough state (quenched in water after tempering) with 0.19 to 0.24% C a shift is shown in the curves of the temperature dependence of the impact strength towards lower tempeatures. A further increase in the C content to 0.55% leads to a shift of these curves towards higher temperatures. On the basis of the change of the quantity of the fibrous component in the fracture of tough specimens with 0.55% C a shift is observed towards increasing temperatures only for the lower branch of the critical cold brittleness range; the first signs of a brittle fracture in this steel is observed at a lower temperature than it is for steel containing 0.42% C. The influence of C on the position of the critical cold brittleness temperature range is most pronounced in tests with brittle specimens (cooled in the furnace from the tempering temperature). In this case an increase in the C content from 0.19 to 0.55% leads to a continuous shift of the critical range of cold brittleness towards lower temperatures. It is concluded that the view that an increase in the carbon content intensifies the tendency to cold brittleness of the steel

APPROVED FOR RELEASE: 09/19/2001 CIA-RDP86-00513R000617320008-4

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GULYAYEV, A P

AUTHORS: Gulyaev, A. P. and Chernenko, I. V. (TsNIITMASh).

TITLE: Influence of the deformation at low temperatures on the phase transformations and the properties of austenitic 1X18H9T steel. (Vliyanie deformatsii pri nizkikh temperaturakh na fazovye prevrashcheniya i svoystva austenitnoy stali 1X18H9T).

PERIODICAL: "Metallovedenie i Obrabotka Metallov", (Metallurgy and Metal Treatment), 1957, No.5, pp. 2-7 (U.S.S.R.).

ABSTRACT: The aim of the here described work was to investigate the influence of deformation at sub-freezing temperatures on the transformation of austenite into martensite and the resulting changes in the mechanical properties of the steel. Specimens of steel containing 0.12% C, 0.48% Si, 1.14% Mn, 0.028% P, 0.02% S, 16.9% Cr, 10.5% Ni, 0.61% Ti, were hardened from 1050°C in water (fullest solution of carbides in the austenite) and some of the specimens were subsequently stabilised by annealing at 800°C for 100 hours (intensive separating out of carbides). The austenite to martensite transformation under the influence of plastic deformation was studied at temperatures +100, +80, +20, 0, -20, -74, -95 and -196°C. The deformation was effected by torsion since in this case the cylindrical shape of the specimen is conserved until fracture and there is a uniform deformation along the entire length of the specimen.

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Influence of the deformation at low temperatures on the phase transformations and the properties of austenitic 1X18H9T steel. (Cont.)

A further decrease in temperatures and an increase in the degree of deformation bring about only an insignificant increment in the martensite quantity. In the case of heating of the deformed specimens at 300 to 500°C an inverse α_2 to γ_2 transformation takes place; the initial temperature of this transformation depends on the quantity of the martensite forming during the process of deformation. The deformation leads to an increase in the strength and a decrease in the plasticity of the metal; for an equal degree of deformation the increase in strength will be larger if the deformation is accompanied by martensite formation. Austenite forming as a result of the reverse α_2 to γ_2 transformation has a higher yield point and relative elongation than austenite of equal strength in which no γ to α_2 transformations took place. Six figures.

Card 3/3

GULYAYEV, A.P.

AUTHORS: Gulyaev, A.P., Doctor of Technical Sciences Prof. and Zel'bet, B.M. Engineer. 129-9-8/14

TITLE: Change in the dimensions of bearing rings during heat treatment. (Izmeneniye razmerov podshipnikovykh kolets pri termicheskoy obrabotke).

PERIODICAL: "Metallovedeniye i Obrabotka Metallov" (Metallurgy and Metal Treatment), 1957, No.9, pp.28-36 (U.S.S.R.)

ABSTRACT: The aim of the here described work was to study the relations governing the change in the dimensions of ball bearings during the heat treatment so as to permit taking these dimensional changes adequately into consideration in the machining additions. Ball bearing rings (races) are manufactured by machining from hot or cold rolled tubes, rods or forgings of the steel ШX15 followed by hardening in oil from 840-850 C and tempering at 160 C followed by grinding to the final dimensions. The influences were investigated of the geometrical parameters on the change in dimensions of the rings during heat treatment, of technological factors (variations in the heat treatment temperatures) on the change in dimensions and the warping of the rings and also the problem of taking into consideration deformations due to the hardening process in establishing the

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necessary grinding additions. The here given results relate to rings made of hot rolled annealed tubes, rods and forgings and they are not applicable to cold rolled non-annealed tubes. Fig.2 gives the dependence of the deformation of the ring on the diameter, the height and the thickness; Fig.3 gives the dependence of the ovality on the diameter and rigidity after heat treatment and after machining; Fig.4 gives the change in ovality during heat treatment as a function of the original ovality; Fig.5 gives the dependence of the deformation and the ovality of rings on the hardening temperature; Fig.6 gives the dependence of the deformation and ovality of rings on the temperature of the hardening medium; Fig.7 gives the influence of preliminary normalisation annealing on the deformation and the ovality of the rings after hardening and after tempering; Fig.8 gives the influence of preliminary heat treatment; Fig.9 gives the influence of tempering at 150 C; Fig.11 gives the dependence of the changes in ovality on the method of loading (horizontal, vertical); Fig.12 gives the change of the external diameter of the outside bearing rings during heat treatment, whilst in the graph, Fig.13, the currently

Change in the dimensions of bearing rings during heat treatment. (Cont.) 129-9-8/14

applied machining additions (in grinding the outside diameter) and the additions proposed by the author on the basis of his experimental results are plotted. The results show that warping (ovality) increases during heat treatment proportionally with increasing diameter and decreasing rigidity (ratio of wall thickness to diameter, S/D) of the ring. Increase of the hardening temperature from 820 to 880 C and of the temperature of the cooling medium from 20 to 80 C and secondary hardening bring about an increase in the ovality. The deformation of the ring depends little on the fluctuation of the temperature during the heating prior to quenching, the temperature of the quenching oil and the preliminary heat treatment. The author proposes a statistical method of determining the deformation of rings and he recommends use of this method for establishing the necessary grinding additions.
There are 13 figures and 2 Slavic references.

ASSOCIATION: Moscow Evening Engineering Institute. (Moskovskiy Mashinostroitel'nyy Institut).

AVAILABLE:

Card 3/3

GULYAYEV, A P

129-1-5/14

AUTHORS: Garashchenko, A.P., Candidate of Technical Sciences, Gulyaev, A.P., Doctor of Technical Sciences, Professor, and Luneva, Z.S., Engineer.

TITLE: Molten Metals and Alloys as a Medium for Heating Steel Components during Heat Treatment (Rasplavlennyye metally i splavy kak sreda dlya nagreva stal'nykh izdeliy pri termicheskoy obrabotke)

PERIODICAL: Metallovedeniye i Obrabotka Metallov, 1958, No.1, pp. 21 - 26 (USSR).

ABSTRACT: Local heating is usually effected in lead baths. In view of the danger to the operating personnel and also the scarcity of lead, attempts are being made to substitute this material by others. As a result of the experiments, it was established that aluminium alloys containing 8 to 12% Si can be used for heating steel components to be tempered and that aluminium alloys containing 6 - 10% Si and 5 - 7% Fe can be used for heating steel components to be hardened. As regards speed of heating, the here mentioned alloys are equivalent to molten lead. Measures were developed for protecting the crucibles, the thermocouple casing and the components against erosion and also against increased loss of the alloy when removing

Card1/2 the components. For heating components to 700 - 850 °C, the

Molten Metals and Alloys as a Medium for Heating Steel Components during Heat Treatment.

best protection against sticking of aluminium during immersion is coating with dry chalk; the loss in weight in this case will amount to 1 to 3 g/m^2 and the loss in dimension will amount to 0.02 - 0.045 mm. The protective lining of the crucibles consists of 60% ground chamotte, 35% fire-resistant clay and 2 - 5% borax to which 10 to 15% in weight of the entire mass is added of a mixture of 50% water and 50% liquid glass. The thermocouple casing and laboratory crucibles are protected by a chalk paint consisting of 62% molten chalk, 8% liquid glass and 30% water.
There are 3 figures and 4 tables.

ASSOCIATION: All-Union Tool Scientific Research Institute (Vsesoyuznyy nauchno-issledovatel'skiy Instrumental'nyy Institut)

AVAILABLE: Library of Congress.

AUTHORS: Gulyayev, A. P., Zel'bet, B. M. SOV/163-58-1-44/53

TITLE: Diagrams of the State of Volume of Phases in Steels (Diagramma ob"yemnogo sostoyaniya faz v stali)

PERIODICAL: Nauchnyye doklady vysshey shkoly. Metallurgiya, 1958, Nr 1, pp 239-243 (USSR)

ABSTRACT: In the present paper the authors experimentally constructed the diagrams of the state of volume of phases with the determination of the martensite points as well as the specific volume of austenite and martensite at different temperatures on one and the same material.
The steel ShKh15 [with 1% C, 1,4% Cr] was used as initial material. The samples of steel ShKh15 were heated to different temperatures within the temperature range from 800 to 960° and then were rapidly tempered in salt water.
The phase state of the steel ShKh15 after tempering and as dependent on different temperatures was investigated. The results obtained supply a complete picture of the phase composition in tempered steel, the parameter magnitude of the lattices and partly also of the qualitative ratio prevailing.
The specific volume of cementite was determined at room tempera-

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Diagrams of the State of Volume of Phases in Steels

ture in relation to the carbon content in solid solutions. The coefficient of linear expansion α of martensite and austenite within the range from 200 to 220°C was determined in relation to the carbon content. It was shown that the α of martensite and austenite practically does not depend on the carbon content in these phases. The martensite transformation in steel begins with the reaching of a certain difference between the specific volume of austenite and martensite, viz., at $0,0044 \pm 0,0002$ cm^3/g, and at a certain difference in the interatomic distances of austenite and martensite of 0,80 Å. An empirical dependence of the coefficient of expansion in volume of austenite and martensite on the temperature was found, which can be calculated by the following formula:

$$\beta_{t_m'} = 30,36 \cdot 10^{-6} + 0,049 \cdot 10^{-6} t; \ \beta_{t_a} = 62,31 \cdot 10^{-6} + 0,02? \cdot 10^{-6} t$$

The constructed diagram of the state of volume of the phase of steel ShKh 15 may be used in practice in the investigation of the rules governing the changes in volume in thermal treatment. There are 2 figures, 5 tables, and 7 references, 6 of which are Soviet.

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SOV/163-58-1-44/..

Diagrams of the State of Volume of Phases in Steels

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening School for Machine Building)

SUBMITTED: October 1, 1957

Card 3/3

GULYAYEV, A.P.

129-2-10/11

AUTHORS: Bogachev, I.N., Grozin, B.D. and Gulyayev, A.P., Doctors of Technical Sciences, Professors.

TITLE: Scientific and Technical Conference on Heat Treatment of Metals Held in Warsaw (Nauchno-tekhnicheskaya konferentsiya po termicheskoy obrabotke metallov v Varshave)

PERIODICAL: Metallovedeniye i Obrabotka Metallov, 1958, No.2, pp. 52 - 55 (USSR).

ABSTRACT: The Polish Society of Mechanical Engineers convened a conference for October 7 - 8, 1957 on heat treatment of metals, in which about 1 500 people participated from Poland and there were also delegates present from the Soviet Union and East Germany.
S. Przegalinski read a paper on "The Principles of Selection of Alloy Structural Steel"; this author believes that excessive importance is attached to ductility properties and considers that important criteria in selecting structural steels are the structure in the hardened state and also the hardness distribution along the cross-section. The authors of this report do not fully agree with some of the opinions expressed in this Polish paper.
Prof. A.P. Gulyayev read the paper "Isothermal Transformation of Austenite in High-speed Steel" which was originally published

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Scientific and Technical Conference on Heat Treatment of Metals Held in Warsaw.

in No.12, 1956, of this journal. At the sectional meeting, A. Moszczynski and G. Matyj read the paper "Chemical-heat Treatment Inside Liquid Media Using Induction Heating" which attracted great attention; they described a simple method consisting of submersion of the inductor and a specimen into a liquid which contained the elements necessary for saturating the steel. After heating of the specimens by the current, the liquid surrounding the specimen starts to evaporate and forms a vapour shell; the vapour decomposes, forming elements in the atomary state which are absorbed by the surface of the steel and diffused into the steel. The inductor voltage must be so chosen that thermal equilibrium is reached and the desired isothermal process is obtained. Some results relating to case-hardening, nitriding and cyaniding are mentioned in the paper.

L. Kalinowski read the paper "Carbon Balance During Gas Cementation"; according to his calculations, only 2 - 4% of the carbon which streams into the furnace is absorbed by the metal, 36-50% is removed with the gases and 42 - 60% settles as soot.

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W. Witek read the paper "Gas Cementation by means of Liquid Hydrocarbons".
S. Kowal read the paper "Cementation of Steel by means of Natural Gas".
Two papers were devoted to heat treatment of case-hardened steels, namely:
J. Wyszkowski read the paper "Heat Treatment of Case-hardened Steels Taking Into Consideration the Grain Size", showing that the heat treatment after case-hardening should be determined by taking into consideration the grain size.
Z. Leszczynski, J. Lemnicka and J. Lemnicki read the paper "Chemico-thermal Treatment of Gears".
E. Zmichorski read the paper "Heat Treatment of Long Tools Made of High-alloy Steels", describing an original design of an electrode-salt bath for heating prior to hardening of reamers made of high-speed steel, a sketch of which is shown in Fig.4, p.54.
G. Prignic read the paper "Heat Treatment of Accurate Metering Gauges".
S. Jablonski read the paper "Possibility of Applying Controlled Atmospheres for Heat Treatment in the Polish Industry".

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P. Kosieradski read the paper "Cyaniding Bath".
B. Korwadynski, S. Jablonski and Prof. B. Sachir and J. Madian read the paper "Equipment of Heat Treatment Shops and Heat Treatment Furnaces".
S. Orzechowski read the paper "Application of the Method of Mikved during Control Tests of Steel Components".
M. Kozlowski read the paper "Comparison of the Properties of Components which were Heat-treated by Surface-hardening and by Chemico-thermal Methods"
Dotsent E. Zmachorski read the paper "Influence of Magnetostriction Oscillations on the Changes of the Structure and the Properties of Hardened Steels"; he investigated high-carbon steels with 1.13 - 1.60% carbon, containing 1.3-2.8% chromium and no chromium.
Prof. F. Sztaub read the paper "Microhardness and Structural Components of Induction-hardened, High-speed Steels", showing that the microhardness of the carbide phase changes as a function of the heat treatment regime (Fig.5).
Ya. Tymowski read the paper "Comparison of the Properties of Structural Steels Improved by Heat Treatment and of Isothermally-hardened Structural Steels", in which he analyses literary data.

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He showed that alloy steels containing carbide-forming elements have higher creep values at 350 - 550 °C after isothermal heat treatment to obtain acicular troostite.

There are five figures.

AVAILABLE: Library of Congress

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129-58-7-1/17

AUTHORS: ~~Gulyayev, A. P.,~~ Doctor of Technical Sciences, Professor, Rustem, S.L., Candidate of Technical Sciences and Orekhov, G. N. and Alekseyeva, G.P., Engineers

TITLE: Investigation of New Die Making Steels for Hot Stamping of High Temperature Alloys (Issledovaniye novykh shtampovykh staley dlya goryachey shtampovki zharoprochnykh splavov)

PERIODICAL: Metallovedeniye i Obrabotka Metallov, 1958, Nr 7, pp 2-10 + 2 plates (USSR)

ABSTRACT: This study has been awarded a prize at the imeni D.K.Chernov NTO Mashprom competition for the best research work carried out in 1955-1957. For hot stamping the Soviet steels 5KhNM and 5 KhGM were used in the past and were subsequently substituted by various steels not containing molybdenum, which is a scarce material in the Soviet Union. In the introduction the authors summarise the effects of the individual elements thus: tungsten ensures red hardness up to 620°C and improves the wear resistance. A tungsten content exceeding 10% will not bring any further improvement in the properties. On the other hand, it affects adversely the resistance of the materials to temperature

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changes, it brings about an increase in the quantity of ferrite at the hardening temperature and a tendency to form grinding cracks. 2. Molybdenum is twice as effective as tungsten. For an equal hardness, molybdenum steel will have better physical properties than tungsten steel. Molybdenum improves the hardenability, increases the resistance to scoring, improves the hardness. However, it reduces the hardening temperature range, it causes surface decarburisation and makes the steel susceptible to grain growth. 3. Chromium reduces the tendency of the steel to oxidise, improves the hardenability and ensures red hardness up to 425°C. However, longer heating is necessary for dissolving the carbides. 4. Vanadium reduces the grain size. 5. Silicon influences the character of the scale forming in air; instead of a dense film an easily removeable powdery oxide is obtained. Furthermore, it increases the wear resistance. Of great importance is carbon which increases the strength, the wear resistance and the hardenability. However, an increased carbon content brings about increased brittleness and scoring

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cracks. Die-making steel contains 0.25 to 0.60% C. Fifteen new grades of die-making steels were developed and investigated. For comparing the properties of these steels the Soviet steel 3Kh2V8 has also been investigated and the respective values are used as reference values. The chemical compositions of the investigated steels are entered in Table 1, p.3. A technique has been developed for testing die-making steels. The obtained results are described in great detail; they are also entered in tables and plotted in graphs. In Fig.1, p.4 the influence of the hardening temperature on the hardness of some experimental steels is graphed. Figs.2-5 (plate) show the micro-structure of some of the investigated steels after various heat treatment regimes. In Fig.6 the dependence is graphed of the hardness of some of the experimental steels on the tempering temperature. Fig.7 shows the hardenability of the experimental steels. Fig.8 shows the dependence of the strength of the experimental steels on the test temperature. Fig.9 shows the dependence of the yield point of the investigated

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steels on the temperature. Fig.10 shows the dependence of the relative elongation of the investigated steels on the temperature. Fig.11 shows the dependence of the relative contraction of these steels on the temperature. Fig.12 shows the dependence of the impact strength of the investigated steels on the temperature. Fig.13 shows the hot hardness of the experimental steels. Fig.14 indicates the resistance to temperature changes of the individual experimental steels. Table 2 gives the hardness of the investigated steels after hardening and tempering from various temperatures. Table 3 gives the hardness of the experimental steels after heating to the hardening temperature and cooling under various conditions. The main data on the mechanical properties and chemical compositions of the experimental steels are summarised in Table 5. The mc [illegible] portant properties of these steels from the point of view of manufacturing dies were determined. Furthermore, four steels for manufacturing dies to be used for stamping high temperature steels are proposed, the chemical analyses of which

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are entered in Table 6, p.10. The authors advocate testing these steels under shop conditions.
There are 14 figures, 6 tables and 7 references, 1 of which is Soviet, 1 German and 5 English.

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening Mechanical Engineering Institute)

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SOV/129-58-11-7/13

AUTHORS: Gulyayev, A. P., Doctor of Technical Sciences, Professor, Luneva, Z.S., Korolev, G. G. and Samoylov, V.V., Engineers

TITLE: Heat Treatment of Tools Made of High Speed Steel in a Steam Atmosphere (Termicheskaya obrabotka instrumentov iz bystrorezhushchey stali v atmosfere para)

PERIODICAL: Metallovedeniye i Obrabotka Metallov, 1958, Nr 11, pp 39-44 (USSR)

ABSTRACT: According to data of various authors, the service life of tools made of high speed steel is increased by 50 to 100% if they are heat treated in steam after being finish—machined and ground. In order to establish the effectiveness of such heat treatment, the authors carried out experiments with specimens and drills made of the steels R9 and R18 which, prior to treatment with steam, were hardened, tempered, sharpened and ground. The treatment with steam was effected in a hermetically closed electric furnace, a sketch of which is shown in Fig.2, in which the temperature was maintained automatically within $\pm$ 5°C. The steam pressure was maintained at 0.1-0.2 atm. To prevent the formation of Fe_2O_3 on the machined surfaces, the steam has to be introduced in the super-heated state.

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Heat Treatment of Tools Made of High Speed Steel in a Steam Atmosphere

Only then will a film form consisting of magnetic iron oxides which is the reason for the high corrosion stability and the good appearance of the thus treated tools. The treatment procedure is graphed in Fig.1. Prior to introducing steam, the temperature is raised to 350-370°C and the tools are held at that temperature for 20 to 30 mins. Then, steam is introduced and the temperature is maintained at the same level for a further 30 mins. Following that, the temperature is raised to 540-550°C, maintained constant at that temperature for 30-60 mins and, finally, cooled in air and quenched in oil. The graph, Fig.3, shows the measured thickness of the oxide film on the steel R9 treated in a steam atmosphere at various temperatures with a holding time of 30 mins; in Fig.4 the thickness is graphed of the oxide film on the steel R9 treated in a steam atmosphere at 550°C as a function of the holding time. It was found that the oxide film produced by steaming is considerably denser than that produced by alkali oxidation. The corrosion stability and the

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Heat Treatment of Tools Made of High Speed Steel in a Steam Atmosphere

resistance to seizure was also measured as well as the service life. On the basis of the obtained results a heat treatment regime in a steam atmosphere was developed for tools made of high speed steels. The steam treatment is recommended as an additional treatment of sharpened and ground tools for the purpose of improving their resistance to corrosion and their cutting performance. Steam is also recommended as an atmosphere in the furnace during tempering for the purpose of preventing erosion of the tool surface; in this case no inter-cycle chemical treatment is necessary. After steam treatment at 500 to 600°C a dense film of the magnetic oxide Fe_3O_4 forms, the thickness of which is 1-4μ. The presence on the surface of such a film leads to an increase of the adhesion temperature (build up of machined metal onto the high speed steel) by 100-150°C and this explains the improved cutting properties; furthermore, steam treatment does not bring about a drop in the surface quality during heating in saltpetre and in air, which is also important from the

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Heat Treatment of Tools Made of High Speed Steel in a Steam Atmosphere

point of view of improving the service life of the tool. Steam treatment is at present applied by numerous Works and should be used on a larger scale.
There are 9 figures, 1 table and 4 references, 3 of which are English, 1 French.

ASSOCIATIONS: VNII, Zavod "Frezer" ("Frezer" Works) and ZIL

1. Tools--Heat treatment 2. Tool steel--Properties
3. Steam--Metallurgical effects

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SOV/126-6-5-13/43

AUTHORS: Gulyayev, ~~A.P.,~~ and Zel'bet, B.M.

TITLE: Diagram of the Phase Volumes of Steel ShKh15 (Diagramma ob"yemnogo sostoyaniya faz v stali ShKh15)

PERIODICAL: Fizika Metallov i Metallovedeniya, 1958, Vol 6, Nr 5, pp 843 - 848 (USSR)

ABSTRACT: Yur'yev's "phase volume diagram" (Ref 1) shows the change in specific volume of individual phases in Fe-C alloys (austenite, martensite, α and γ-iron and cementite) with change in temperature. From a consideration of this diagram he concluded that, irrespective of carbon content, the transformation of austenite into martensite commences at a definite specific volume of austenite, which for carbon steel is

0.12590 ± 0.00010 cm^3/g. In general, this means that austenite transforms at the moment when the iron atoms in the γ-lattice, due to contraction on cooling, reach a definite limiting distance. This agrees with earlier assumptions by Sadovskiy and Yakutovich (Ref 2), who specified 3.607 Å as the critical lattice parameter of austenite at which martensite begins to form. However,

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Diagram of the Phase Volumes of Steel ShKh15

other authors (Refs 3, 4 and 5) disagree with this view. Taking Kurdyumov's mechanism of martensite transformation (Ref 6) as the basis, Arkharov proposed certain crystal geometry relationships which must be satisfied for the initiation of martensite formation. The martensitic $\gamma \rightarrow \alpha$ transformation, according to Kurdyumov, consists in a regular shift of atoms in the γ-iron lattice relative to each other by distances less than inter-atomic. Arkharov developed this theory further and stipulated that the distance between the closest atoms along the [101] and [111] directions must attain a certain critical value for the $\gamma \rightarrow \alpha$ change to take place. Figure 1 shows the relationship between the austenitic lattice parameter and temperature but from this diagram there is no evidence to support the above theories, which are based only on literature data. Hence, the authors of this paper decided to construct experimentally a phase volume diagram and determine the M_s point and the specific volumes of austenite and martensite at various temperatures in one material. The steel ShKh15 (1.0% C, 1.4% Cr) was chosen

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Diagram of the Phase Volumes of Steel ShKh15

for this purpose. For the construction of the diagram the specific volumes of the phases (γ, α and cementite) at various carbon contents (for the γ and α-phases) and various temperatures must be known. This information was obtained by quenching the steel specimens from temperatures in the range 800 to 960 $^{\circ}$C in brine. As quenched, the steel structure consists of three phases - martensite, austenite and carbides. The quantitative relationship and composition of the first two phases change with quenching temperature. The results are given in Table 1. If the composition and the lattice parameters of the phases are known, their specific volumes can be calculated (Ref 1), the latter, at room temperature, are given in Table 2. If the coefficient of linear expansion for each phase is determined, the diagram can be constructed. These coefficients were derived experimentally and are given in Table 3. The diagram for the phase volumes of the steel ShKh15 is shown in Figure 2, the position of the M_s point in relation to carbon content and quenching temperature is given in Table 4 and the specific volumes of lattice

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parameters of austenite and martensite at the temperature at which the martensitic transformation commences, in Table 5. From a consideration of the above results the authors arrived at the following conclusions: martensitic transformation of any composition of a given steel does not commence on attaining a constant specific volume, but when a difference between the specific volumes of austenite and martensite of 0.0044 ± 0.0002 cm^2/g and between the interatomic distances along the combined directions of austenite [101] and martensite [111] of 0.080 ± 0.003 Å has been attained. An experimental dependence of the coefficients of volume expansion of austenite and martensite on temperature is expressed by the formulae:

$$\beta_{t_M} = 30.36 \times 10^{-6} + 0.049 \times 10^{-6} \quad \text{and}$$

$$\beta_{t_A} = 62.31 \times 10^{-6} + 0.027 \times 10^{-6} \ .$$

The phase volume diagram for the steel ShKh15 may find practical application for the study of volume changes due to heat treatment.

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Diagram of the Phase Volumes of Steel ShKh15

There are 2 figures, 5 tables and 8 references, 7 of which are Soviet and 1 German.

ASSOCIATION: Moskovskiy vecherniy mashinostroitel'nyy institut (Moscow Evening Institute for Machine Building)

SUBMITTED: February 4, 1957

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SOV/126-6-5-16/43

AUTHORS: Arskiy, V.N., and Gulyayev, A.P.

TITLE: Kinetics of the Formation of Deformation Martensite (Kinetika obrazovaniya martensita deformatsii)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, pp 866 - 873 (USSR)

ABSTRACT: A distinction is made between deformation martensite and quench martensite. The aim of the present work was to investigate the kinetics of the formation of deformation martensite, as well as to compare the process of deformation martensite-formation with that of martensite formation on cooling. The investigation was carried out using nickel steels made in the laboratory, the composition of which is given in Table 1. Besides the elements indicated, the ingots contained approximately 0.25% Si, 0.20% Mn, 0.02% P and 0.02% S. For the study of martensite formation during deformation, the ingots of the investigated steels were forged into rods of 12 mm dia from which tensile test specimens and specimens for the study of the martensitic transformation during cooling were made. Specimens were quenched from 1 220 °C, heating being carried out in

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vacuum. For the study of the formation of deformation martensite, the quenched specimens were pulled in the tensile testing machine IM-12-A. As the specimen was pulled in tension, the quantity of martensite forming was measured at the same time as measurements were carried out of deformation forces by means of a specially constructed magnetometer. The principle of the layout of the apparatus is shown in Figure 1, where 1 - primary-, 2 - measuring-, 3 - compensating coils, 4 - the specimen, 6 - the rectifier. In Figure 2, extension curves and martensite curves for all the investigated steels are shown. The normal martensite curves for the same steels, i.e. curves for martensite obtained on cooling, are shown in Figure 4. Figure 5 shows martensite curves for steel 95N19 as obtained by deformation at various deformation speeds. Martensite curves for conditions under which martensite forms under constant loading ("isobar martensite curves") are shown in Figure 6. The results obtained from the curves of Figures 2 and 4 are given in Table 2. It is shown that externally applied forces cause martensite transformation which can be represented in the form of martensite

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Kinetics of the Formation of Deformation Martensite

curves (see Figures 2 and 5). The lowering in temperature for development of the martensitic transformation is analogous to increase of the externally applied force. The influence of the rate of loading and the magnitude of the constant load for the formation of deformation martensite are shown, the latter being analogous to the influence of the cooling rate and to the temperature of isothermal soaking at which quench martensite forms. The influence of the position of the M_s point and other indicators of the development of the transformation of austenite into martensite during deformation is shown. When the deformation is carried out below the M_s point, i.e. when the specimen already contains a certain quantity of quench martensite, external forces do not lead to a full transformation of austenite into martensite owing to the low plasticity of the specimen. If the load is applied at the M_s temperature, the stresses lead eventually to a complete austenite-martensite reaction. This is due to the austenite above the M_s point being less prone to becoming

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transformed into martensite under the influence of deformation and the higher the deformation temperature in relation to the M_s point the lower the tendency for deformation martensite to form. Thus, the maximum quantity of deformation martensite forms when the deformation temperature coincides with the M_s point. Identical influences of lowering the temperature (below the M_s point) and of increase in force (above σ_M) show that a lowering in temperature causes stresses which lead to martensite formation. Approximate calculations show that in the investigated steels an increase in stress above the yield point by 2 kg/mm^2 causes the formation of approximately 1% martensite. The same quantity of martensite forms when the temperature is lowered by 1 $^\circ$C. It appears that a lowering of temperature by 1 $^\circ$C under the experimental conditions described causes a stress of approximately 2 kg/mm^2.

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Kinetics of the Formation of Deformation Martensite

There are 6 figures, 2 tables and 5 references, 4 of which are Soviet and 1 German.

ASSOCIATION: Tsentral'nyy nauchno-issledovatel'skiy institut tekhnologii i mashinostroyeniya (Central Scientific Research Institute of Technology and Construction of Machines)

SUBMITTED: January 31, 1957

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SOV/126-6-5-30/43

AUTHORS: Gulyayev, A.P., and Zelenova, V.D.

TITLE: X-ray Investigation of the Transformation of Martensite on Tempering a Powder and a Solid Specimen (Rentgenograficheskoye issledovaniye prevrashcheniya martensita pri otpuske v poroshke i v sploshnom obraztse)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, pp 936 - 937 (USSR)

ABSTRACT: In the papers (Refs 1 and 2) a method for the separation of isolated martensite from quenched steel by anodic solution has been described. This method was applied in the present work, the aim of which was to compare the process of martensite decomposition on tempering in a solid specimen with that of isolated crystals of martensite. From X-ray photographs it is evident that in isolated martensite stresses of the second order are considerably less, which confirms earlier conclusions (Refs 1, 3). In order to study the characteristics of decomposition of isolated martensite during tempering, simultaneous heating of the specimen and of the powder was carried out at various temperatures, followed by soaking for five minutes and in the case of other specimens

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X-ray Investigation of the Transformation of Martensite on Tempering a Powder and a Solid Specimen

for various soaking times at 100 °C. The carbon concentration in the solid solution was worked out by the formula:

$$C = \frac{c/a - 1}{0.0467}$$

where C is the weight percentage of carbon in martensite, c/a is the degree of tetragonality of the martensite lattice.

The results of these measurements are shown in Figures 1 and 2. In the residual austenite of the quenched steel compressive stresses arise which must be balanced by tensile stresses in the martensite; these are evidently removed on isolating crystals of martensite. The lattice parameter of the martensite in quenched steel in the solid specimen is 2.983 Å and in the powder of the same specimen 2.969 Å. Hence, tensile stresses enlarge the lattice of

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X-ray Investigation of the Transformation of Martensite on Tempering a Powder and a Solid Specimen

martensite which causes a greater percentage of carbon to be retained in solution. There are 2 figures, and 4 references, 3 of which are Soviet and 1 German.

ASSOCIATION: Gosudarstvennyy nauchno-issledovatel'skiy avtomobil'nyy i avtomotornyy institut (State Scientific Research Automobile and Automobile Engines Institute)

SUBMITTED: May 15, 1957

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SOV/126-6-5-36/43

AUTHORS: Gulyayev, A.P., and Zelenova, V.D.

TITLE: Investigation of Martensitic Transformation in Austenitic Powder (Issledovaniye martensitnogo prevrashcheniya v austenitnom poroshke)

PERIODICAL: Fizika Metallov i Metallovedeniye, 1958, Vol 6, Nr 5, pp 945 - 946 (USSR)

ABSTRACT: Abruzov, N.P. (Refs 1 and 2) showed that the method of electrolytic dissolution of steels is applicable not only for separating out the carbide phase but also for separating out martensite from hardened steel. If steel with austenite as the basic phase component is subjected to electrolytic dissolution, provided certain electrolysis regimes are maintained, a residue can be obtained consisting of isolated γ-phase crystallites. The austenite powder was obtained by anodic dissolution of austenitic steel according to a regime used by N.M. Popova (Ref 3) for separating out the carbide phase, except that instead of cooling the electrolyte (which is recommended for a carbide analysis) it was heated to 30 - 50 °C. Even at temperatures below +5 °C, cooling of the electrolyte leads to a reduction in the content of the austenitic phase in

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